From the
INTERNATIONAL SEARCHING AUTHORITY

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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB2004/003452	11.08.2004	11.08.2003

International Patent Classification (IPC) or both national classification and IPC
H01L51/40

Applicant
CAMBRIDGE UNIVERSITY TECHNICAL SERVICES LIMITED

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☒ Box No. II Priority
- ☒ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:

European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized Officer

Pusch, C

Telephone No. +49 89 2399-7023

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/GB2004/003452

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ in written format

   ☐ in computer readable form

   c. time of filing/furnishing:

   ☐ contained in the international application as filed.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. II Priority

1. ☐ The following document has not been furnished:

   ☐ copy of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(a)).

   ☐ translation of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(b)).

   Consequently it has not been possible to consider the validity of the priority claim. This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43*bis*.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. ☒ It has not been possible to consider the validity of the priority claim because a copy of the priority document was not available to the ISA at the time that the search was conducted (Rule 17.1). This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

4. Additional observations, if necessary:

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application,

☒ claims Nos. 1-24

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination *(specify)*:

☒ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. 1-24 are so unclear that no meaningful opinion could be formed *(specify)*:

see separate sheet

☒ the claims, or said claims Nos. 1-24 are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the whole application or for said claims Nos.

☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:

the written form ☐ has not been furnished

☐ does not comply with the standard

the computer readable form ☐ has not been furnished

☐ does not comply with the standard

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.

☐ See separate sheet for further details

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	26-33
	No:	Claims	25
Inventive step (IS)	Yes:	Claims	
	No:	Claims	26-33
Industrial applicability (IA)	Yes:	Claims	1-33
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

1.0 Reference is made to the following documents:

D1: US-A-5 472 502 (BATCHELDER ET AL) 5 December 1995
D2: US-A-4 347 302 (GOTMAN ET AL) 31 August 1982
D3: US-A-5 670 791 (HALLS ET AL) 23 September 1997
D4: H. TANAKA et al., MACROMOLECULES, AMERICAN CHEMICAL SOCIETY, vol. 24, no. 1, January 1991, pages 240-251, EASTON, US
D5: WO 94/15368 A (RIJKSUNIVERSITEIT TE GRONINGEN; HADZIIOANNOU, GEORGES; HERREMA, JAN; W) 7 July 1994
D6: L. HUANG et al., POLYMER, ELSEVIER SCIENCE PUBLISHERS B.V, GB, vol. 44, no. 6, March 2003 , pages 1967-1972

Item III

Non-establishment of opinion

III.1 Claim 1 do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claim attempts to define the subject-matter in terms of the result to be achieved namely of selecting an unspecific value for the solvent drying time, an unspecific temperature of the first electrode and an unspecific weight ratio of semiconducting to dielectric material without giving guidance for the specific values. This merely amounts to a statement of the underlying problem of forming a phase separated layer of exactly two layers, without providing the technical features necessary for achieving this result.

The following parameters are prerequisite for achieving **lamellar** (p. 13, l. 13 or 23) phase separation according to the description of the present application are not listed in claim 1:
- a **single** solvent (p. 17, l. 2) in which the semiconducting and the dielectric material are dissolved;
- fast solvent evaporation/drying time in the range **of 01. - 100 s** (claim 3 and p. 15, l. 20 - 24);
- **molecular weight** of the semiconducting and the dielectric material (p. 19, l. 17 - 19 or p. 22, l. 17 - 20) as well as the **weight ratio of these materials of 0.5 - 2** (claim 2

or p. 15, l. 9 - 15 or p. 17, l. 4- 10);
- temperature during phase separation given as the **temperature of underlying electrode** (p. 17, l. 5 - 9)
- **low cohesive energy density of the dielectric material** (p. 24, l. 23 - p. 25, l. 11) of **less than 300 J/cm3** (p. 26, l. 25 - 28) and **content of low cohesive energy structural units of 25% - 95%** (p. 28, l. 1 - 3);
- **interaction parameter of greater than 1 for a monomer (oligomer)-polymer-solvent system or of more than 0.05 for a polymer-polymer-solvent system or the diblock polymer system** (p. 25, l. 15 - p. 26, l. 10).

III.2 Including the above parameters in an independent method claim still does not enable the skilled person to carry out the claimed invention, because the description and the examples fail to give specific values for the molecular weight of the semiconducting and the dielectric materials, for the length of the semiconductor block and the dielectric block (page 21, line 3 - page 22, line 6), and most important for the temperature of the underlying electrode ("a bilayer structure ... is obtained when optimised" p. 45, l. 2/3 or l. 16/17). Therefore, the present application does not comply with Article 5 PCT.

Due to the above lack of clarity and lack of disclosure the novelty and inventive merit of the subject-matter of method claims 1 - 25 is not assessed in this communication.

III.3 A blend of two semiconducting polymers in a solvent is deposited in D3 on a first electrode (fig. 2, col. 7, l. 48 - 64; drying time several hours (col. 9, l. 44 - 48), weight ratio 1:1 (col. 9, l. 39 - 43)). The polymers phase separate by self-organisation into first domains of the first polymer and second domains of the second polymer (col. 12, l. 54 - 62) but do not phase separate to from an interface between the material for forming the first polymer layer and the material for forming the second material layer.

III.4 D4 describes depositing a layer of a solution containing two materials (SI) and (HS) for forming layers (SI) and layers (HS) wherein the solvent drying time is over a month at 30 °C (p. 241, col. 2, l. 32), the weight ratios of a poly(styrene-b-isoprene) diblock polymer (SI) and a homopolystyrene (HS) are 4:1 - 1:4 (p. 242, figure 3: "80/20" - "20/80") in the solution so that the materials separate by self-organisation to

form a plurality of interfaces between the material (SI) and the material (HS). It is remarked that under the process conditions of D3 only the weight ratio of 4:1 (0.25 or 4) resulted in a lamellar phase separation (fig. 3 and p. 242, col. 2, l. 4 - 11) contrary to the teaching of the present application where a ratio of 0.5 - 2 is suggested.

It is contested that the feature of a semiconducting material and a dielectric material in the present application contrary to two dielectric materials in D3 is the parameter prerequisite for obtaining two layers separated by one interface. It is also doubted that the feature of a solvent drying time of 0.1 s - 100 s as suggested in the present application instead of a longer solvent drying time as in D3 is responsible for the exactly separation into two layers with an interface.

III.5 In D5 a solution containing material (p. 6, l. 4 - 9) for forming a semiconductive layer and a material for forming a dielectric layer (p. 7, l. 13 or 25 and p. 8, l. 29 - 32) are deposited on a first electrode (p. 15, l. 24 - 26). The ability of block copolymers to self-assemble is mentioned.

III.6 Monte-Carlo simulation of self-assembly of melts of diblock polymers with given interaction parameters are presented in D6 (e.g. fig. 2(a)). However, according to this document, only homopolymer blends are known for macro phase separation (squares in fig,. 3 and p. 1970, col. 1, l. 11- 13).

Item V

Reasoned statement under Rule 43bis.1(a)(I) (N, IS, IA)

2.0 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 26 is not new in the sense of Article 33(2) PCT.

The document D1 discloses (the references in parentheses applying to this document):

An apparatus for controlling solvent drying time during deposition of a solution containing material for forming one or two polymer layers on a substrate in an

electronic or optoelectronic device(abstract), said apparatus comprising a plate (col. 9, l. 16/17 and "306-11" in fig. 11a or 11b) for carrying the substrate ("302"); characterised in that the plate is positioned inside an enclosure (col. 10, l. 1-3 "1102-A" and "1104-A" in fig. 11a or 11b), said enclosure having a solvent inlet port (col. 9, l. 34/35 "312") and an outlet port (col. 10, l. 18/19 and "1108").

The subject-matter if apparatus claim is not new.

3.0 Dependent claims 27 - 33 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step.

Heating of a table (chuck) during deposition of a polymer on a substrate is a feature known in the field of deposition apparatuses, as is a grid for maintaining even gas flow. The apparatus of D1 is used in the manufacture of semiconductor devices and flat panel displays (col. 1, l. 7 - 10).

Item VIII
Clarity

VIII.2 It is assumed that the semiconducting material forms the channel region of the transistor and the dielectric material forms the gate dielectric of the transistor. However, this is not clear from the claims but only from the examples in the description of the present application.

VIII.3 Claims 1 and 23 have been drafted as separate independent claims. However, as claim 23 contains all the features of claim 1 it should be made dependent on claim 1. Moreover, the objections under item III.1 and III.2 for claim 1 equally apply for claim 23.

VIII.3 The word "optionally" does not induce a limiting effect on the scope of claims 1 and 23. Optional features should be drafted in dependent claims.

VIII.4 A device has to be characterised by device features directly discernable in the final device and not by the method of its manufacture. Moreover, the dependence of device claim 25 on method claims 23 or 24 claims renders its category unclear.

VIII.5 The feature in the apparatus claim of controlling the solvent drying time in claim 26 relates to a method of using the apparatus rather than clearly defining the apparatus in terms of its technical features. The intended limitations are therefore not clear from this claim, contrary to the requirements of Article 6 PCT.
The mere technical features of a plate for carrying the substrate, the plate being positioned inside an enclosure, said enclosure having a solvent vapour inlet port and an outlet port are known (see item 2.0 under item V).

VIII.6 Including the features of claim 3 into claim 1 does not render the claim clear. It is not explained how it is assured that the bilayer phase separated film is dry after a drying time of 01. s - 100 s.

VIII.7 Surface tension is a property of a fluid on a solid. It is not clear how the material for forming the dielectric layer in claim 13 can be characterized by its surface tension.

VIII.8 Claim 20 is superfluous. The transistors of claims 14 and 15 on which claim 20 depends are necessarily field effect transistors.